

The effect of the South African curriculum change process on mathematics teacher roles

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In this paper I discuss an analysis of mathematics curriculum change in post-apartheid South Africa. I do this analysis from the perspective of the roles the new curriculum implies for mathematics teaching. I will argue that the new roles demanded of teachers are complex, comprising multiple strands that, at present, are emerging as conflictual rather than complementary for teachers. I begin this paper with a brief discussion of the socio-political context that gives rise to the new curriculum, as backdrop to the description of the curriculum that follows. I then provide a sketch of the wider study of which this analysis forms part, and so situate my focus on teachers' roles within a theoretical and methodological framework. The paper concludes with examples and a discussion of conflict which arises, in relation to these roles, in curriculum implementation.

The social and political context within which the study takes place

South Africa is currently embarking on radical educational reform. The need for a complete overhaul of the education system under apartheid has been identified as a priority for building a new democratic South Africa. Thus educational change has been stimulated by the major political changes which occurred in the country during the 1990s and which brought about the abolition of apartheid and the introduction of a democratic South Africa. The vision for education that emerged was to integrate education and training into a system of lifelong learning. Outcomes-based education (OBE) was adopted as the approach that would enable the articulation between education and training, recognition of prior learning and thus increased mobility for learners. A new curriculum, Curriculum 2005, was developed for implementation. Curriculum 2005 has three distinctive sources, these are a philosophy of learner-centred education, Outcomes-based education and an integrated approach to knowledge (Chisolm et al, 2000). Curriculum 2005 applies to all bands of education, including Early Child Development, General Education and Training (GET, grades 1-9) and Further Education and Training (FET, grades 10-12), but currently details of the curriculum are only available in the GET band.

A distinguishing feature of Curriculum 2005 is its up-front political agenda. Curriculum 2005 is a vehicle for restructuring South African society along democratic principles. This is captured in the introduction to the Curriculum 2005.

The curriculum is at the heart of the education and training system. In the past the curriculum has perpetuated race, class, gender and ethnic divisions and has emphasised separateness, rather than common citizenship and nationhood. It is therefore imperative that the curriculum be restructured to reflect the values and principles of our new democratic society. (National Department of Education (NDE), 1997).

These underlying goals of Curriculum 2005 have taken shape in the new maths curriculum and in its demands for new teacher roles. Before describing these changes, I discuss briefly the broader study from which this paper is drawn and why an analysis of curriculum change from the perspective of teacher roles and identity is important.

The empirical field of the study

The context of curriculum change implies an important role for in-service work with teachers. The Programme for Leader Educators in Senior-phase Mathematics Education (PLESME) was developed in order to create leader teachers in mathematics with the capacity to interpret, critique and implement current curriculum innovations in mathematics education in South Africa. Other major aims included:

- enabling and fostering collegial and co-operative ways of working with other mathematics teachers within schools and between schools

- fostering co-operative ways of working with departmental mathematics subject advisors and district offices to assist in implementing and reviewing mathematics curriculum innovations

- developing necessary skills and knowledge for running workshops with groups of teachers on a range of mathematics topics related to current curriculum innovations

Assessment was portfolio-based. Portfolios included, for example, teacher conference presentations, materials and booklets designed by teachers, teachers' input into the Report of the Review Committee on Curriculum 2005, workshops teachers organised and ran, classroom videos and teachers' written reflections on lessons etc. PLESME worked with teachers from schools in Soweto and Eldorado Park (both urban townships outside Johannesburg) over a two-year period. This INSET programme provided the empirical field for my study.

In PLESME I wore two hats. Firstly I was the co-ordinator of PLESME. I raised funds for it, designed it, set up a steering committee and negotiated with schools, districts and teachers as to the nature of the of the project. This was my full time vocation for the period of October 1998 – June 2001 and I was accountable to my organisation, the university, the steering committee, donors, teachers and schools on the value and 'success' of the project. At the same time, I was a researcher in the process of conducting research on the nature of mathematics teacher learning in relation to INSET within the context of rapid curriculum change.

I was expecting some tension to emerge in relation to my role as an 'INSET co-ordinator' *and* my role as 'researcher.' I was expecting this primarily because I had struggled to distinguish these roles clearly in the research proposal. I discovered however that no such tension emerged in practice and the tension remained a primarily theoretical tension. Instead I discovered a powerful praxis in

the duality of being both INSET worker and researcher. It enhanced and enabled a form of action-reflection practice that I had been unable to achieve with success in previous INSET projects. For example, reflecting on interviews, lessons and other data helped me to develop research ideas and refine my research objectives. It led to asking specific questions in interviews and questionnaires that related specifically to my research interest in understanding the nature of teacher learning. However such reflection on data also led to the re-planning of PLESME activities and the design of additional activities that enhanced teacher participation and teacher learning. For example, interviews became a combination of discussions as a necessary part of praxis and discussions that were geared towards gathering data necessary to assist me in answering my research questions. Similarly my ongoing reflection in the form of journal entries (relating both to PLESME and my work as a researcher) and the readings I was engaged with helped me reflect on how to improve PLESME.

I found enormous advantage in this duality of roles. Working closely with teachers in PLESME helped give form to the research and the research process **and** enabled more sensitivity and reactivity by myself in PLESME. My own learning in terms of becoming a more experienced 'INSET provider' was maximised by the ongoing reflection, which was stimulated by the research.

Teacher learning, roles and identity

The study explores mathematics teacher learning in relation to how teachers participate in and make use of a community of practice, stimulated by PLESME in the context of curriculum change. The study is broadly located in social practice theory. Within this field, Lave & Wenger's (1991) notion of legitimate participation in communities of practice is becoming increasingly popular to explain learning. According to their model, learning is located in the process of co-participation, the increased access of learners to participation and in an interactive process in which learners simultaneously perform several roles. Participation in this sense is the process of 'being active participants in the practices of social communities and constructing identities in relation to these communities' (Wenger, 1998, p.4). Learning and a sense of identity are aspects of the same phenomenon (Lave & Wenger, 1991). Previous research conducted by Graven (1998) indicates that teacher education should involve bringing teachers into supportive communities where reflection-in-practice is enabled. Lave and Wenger's model of learning supports this conclusion and it is expected to provide some useful insights for analysis of the broader study.

My assumption is that the implementation of the new curriculum does not simply involve following a set of curriculum instructions or replacing 'old' practice with 'new' practice. Rather implementation is a process of fashioning the curriculum in such a way that it becomes part of the teacher's 'way of being'. In fashioning the curriculum in this way, teachers will 'change' themselves and

modify the curriculum. My assumption is that this learning will take place within the context of participation within the INSET practice, which includes practice within schools. These assumptions were not evident to me at the start of the research study but rather developed over time through observing teachers make sense of the new curriculum and reflect on their learning process. In interviews with teachers about their learning within the context of PLESME, it became evident that teachers themselves, saw their learning as a process of developing a different ‘way of being.’ Here are just two quotes from teacher interviews to support this statement:

You know before I always used to introduce myself as the music teacher, now I introduce myself as the maths teacher [T1, 20/07/99]

It (PLESME) has broadened my horizons very much...For myself, if I open a newspaper I think what can I use in my class, or think this is another way of drawing a graph... Like the example we did on holiday, I start to realise how much they (advertisements) are bluffing you. I use it in everyday life...[T2, 22/06/99]

Two key notions which I draw on are teacher roles (designed by the national department of education) and teacher identities (which form in uneven ways in relation to change). The object of the broader study is to elaborate on the relationship between these. I believe that analysis of curriculum change from the perspective of teacher roles and identities is original and has much to contribute to understanding curriculum in practice.

The study uses qualitative ethnography as its research methodology, in which I work as a participant observer. Because teacher learning is analysed within the context of radical curriculum change, a major part of the study has involved thorough documentary analysis of the new curriculum and related literature. It is this part of the study, which is the focus of this paper. For a more detailed analysis which is beyond the scope of this paper see (Graven, 2001). I have primarily drawn on the work of Bernstein (1982, 1996) for tools for curriculum analysis. In this paper I draw on Bernstein’s differentiation between competence and performance based pedagogic models (Bernstein, 1996). According to Bernstein, performance models serve primarily economic goals and are considered instrumental. They emphasise specialised skills necessary for the production of specific outputs. In contrast, competence models foreground the cognitive and the social, and acquirers apparently have a greater measure of control over selection, sequence and pace. I also draw on Bernstein’s concept of *Official Projected Identities* which refers to the identity projected by an institution (in this case the NDE).

Changes in the mathematics curriculum and teacher roles

My purpose here is to describe the changes found in mathematics curriculum documentation and to unpack the new roles for teachers. Firstly, the subject *Mathematics* is replaced with the broader Learning Area *Mathematical Literacy, Mathematics and Mathematical Sciences* (MLMMS). This learning area represents

a major shift in the philosophy of mathematics and mathematics education. Three main philosophical shifts can be identified. These relate to the approach to mathematics teaching, the nature and contents of mathematics and the role of mathematics education. I will deal with each of these changes briefly.

MLMMS defines mathematics as:

the construction of knowledge that deals with qualitative and quantitative relationships of space and time. It is a human activity that deals with patterns, problem-solving, logical thinking etc., in an attempt to understand the world and make use of that understanding. This understanding is expressed, developed and contested through language, symbols and social interaction (NDE, 1997, p.2).

This definition places an emphasis on more socio-constructivist, learner-centred and integrated approaches to mathematics teaching and learning. This indicates a move away from the previous performance-based approach towards a more competence-based approach. Furthermore this definition indicates a shift away from the 'absolutist paradigm', which views mathematics as a body of infallible objective truth which has little to do with the affairs of humanity (Ernest 1991). The *Rationale* to MLMMS further states that mathematics should empower learners to 'understand the contested nature of mathematical knowledge' (NDE, 1997). MLMMS focuses its attention on constructing mathematical meaning in order to understand the world and make use of that understanding. Mathematical learning is to be relational, flexible, transferable and integrated with everyday life and other learning areas. The specific outcomes for MLMMS indicate changes in the contents of school mathematics. The importance of data, space and shape (not simply Euclidean geometry), history of mathematics and cultural, social and political applications of mathematics are all new. For example, Specific Outcome 4 is: 'Critically analyse how mathematical relationships are used in social, political and economic relations' (NDE, 1997, p.3).

The specific outcomes support the important role charged to MLMMS for helping to build a new democratic, equitable, non-racist, non-sexist South Africa. Political aims are also clear in the *Rationale* for MLMMS which states that MLMMS must empower people to:

work towards the reconstruction and development of South African society;
develop equal opportunities and choice;
contribute towards the widest development of the society's cultures;
participate in their communities and in the South African society as a whole in a democratic, non-racist and non-sexist manner etc. (NDE, 1997)

In sum, MLMMS demands major philosophical shifts of teachers and learners. These shifts effect teacher roles and hence the development of mathematics teacher identities. As is well documented (Thompson, 1992), bringing about change in teacher conceptions of mathematics is a difficult and long term process. It is therefore important that the enormity of these demands is not underestimated.

Further analysis of MLMMS shows four different orientations of mathematics.

- Mathematics for critical democratic citizenship. It empowers learners to critique mathematical applications in various social, political and economic contexts.
- Mathematics is relevant and practical. It has utilitarian value and can be applied to many aspects of everyday life.
- Mathematics inducts learners into what it means to be a mathematician, to think mathematically and to view the world through a mathematical lens.
- Mathematics involves conventions, skills and algorithms that must be learnt. Many will not be used in everyday life but are important for further studies.

An understanding of school mathematics, in terms of the four orientations, demands that mathematics teachers develop related 'roles' in relation to their teaching practice. Four related mathematics teacher roles are thus identified:

1. The teacher's role is to prepare learners for critical democratic citizenship. The teacher becomes a critical analyser of the way mathematics is used socially, politically and economically and supports learners to do the same.
- The teacher's role is a local curriculum developer and an applier of maths in everyday life. The teacher brings maths from 'outside' into the class.
 - The teacher's role is to be an exemplar 'mathematician' or someone who has an interest in pursuing mathematics for its own sake. The teacher apprentices learners into ways of investigating mathematics.
 - The teacher's role is as a 'custodian' of mathematical knowledge or a deliverer of mathematical conventions, algorithms etc. which are important for MLMMS in general and will enable success in the FET band. The teacher is a 'conveyor' of the practices of the broader community of mathematics teachers.

In this vision for change, we need to ask whether these roles are realisable. Is it possible for teachers to perform each of these mathematical roles? Is it reasonable to expect teachers to integrate across these roles? It is beyond the scope of this paper to engage in a theoretical discussion about this. Instead I move on to looking at some of the tensions that emerge, in relation to these roles, in the implementation of the new curriculum.

Some tensions in working with the mathematics orientations and teacher roles

While the four orientations and related roles are presented separately, this should not imply exclusivity. These orientations should work together in support of each other. While the assumption in MLMMS is that these orientations can and do co-exist, this is not how they are presented to teachers in practice. Rather than presenting a view of mathematics, which integrates all four of these orientations and roles, curriculum support presents conflicting messages as to which orientation is 'best'. Official support for primary school mathematics teachers, at district level

tends to focus on the 1st and 2nd orientations while viewing the 4th orientation, most familiar to teachers, as 'old.' On the other hand support provided to teachers which is aimed at improving performance in mathematics examination results emphasises the 4th orientation at the expense of the first three. Let me elaborate with two examples.

Illustrative Learning Programmes (ILPs), were designed by the Gauteng Department of Education (GDE) and the Gauteng Institute for Curriculum Development (GICD), to support teachers in developing theme-based and integrated learning materials. The first ILP for MLMMS, grade 7 was 'Farming and Growth.' Analysis of this 50 page document reveals that only approximately one quarter of the activities relate to mathematics and that most of these mathematics activities simply 'apply' maths skills which are assumed to be available to learners. The mathematics in this ILP works with the 2nd orientation at the expense of the other three orientations. This ILP has been heavily criticised by mathematics teachers and educators. Minutes of the Primary Mathematics Working Group Session at AMESA 2000 reflect that teachers feel that there is not enough mathematics in this ILP. Chisolm et al (2000) note that the ILP shows that the emphasis on integration has compromised coherent mathematical development and that the mathematical content is obscured.

On the other hand official support aimed at the improvement of 'performance', emphasise the 4th orientation by stressing algorithms, procedures and definitions. At the start of my work with the PLESME teachers I was invited to a district level workshop for 'Soweto' teachers. These teachers were invited to a previously 'white' school for the workshop. At this workshop the teachers from this school provided the 'Soweto' teachers with photocopies of their mathematics schemes of work. These schemes of work did not reflect any current curriculum developments and only focused on the 4th orientation of mathematics. The common assessments given to Soweto schools were based on this scheme of work and did not reflect any of the first three orientations. For example the exam asked learners to define various mathematics terms and excluded geometry because according to the scheme of work this is only dealt with in the final term. The justification for the insistence of the use of these schemes of work and assessments is that they are derived from a 'top performing' school in the district. [Taken from journal entry, February 1999]

Such actions by the part of district workers, which undermine teacher attempts to implement new curriculum ideas and exclude teachers from making decisions related to the teaching and assessment of their learning area, will effect the morale of teachers. Furthermore, they will prevent, rather than support, teachers from developing new roles which resonate with MLMMS and broader curriculum changes. In a context of a post-apartheid South Africa the racial undertones of such an incident are particularly problematic and worrying.

Thus two contradictory official identities are being projected, that of the incoming curriculum and that of the outgoing curriculum. The Official Projected

Identity (Bernstein, 1996) of MLMMS emphasises the 1st and 2nd orientation (although it does include the 3rd and 4th orientation these are, in practice, less emphasised) while the Official Projected Identity related to the outgoing (but still predominantly implemented) curriculum emphasises the 4th orientation. Since there are currently two curricula existing within the school system, the incoming competence-based model and the outgoing performance based-model (Bernstein, 1996), provincial departments and district workers are in the difficult position of having to work out when it is appropriate to work with which Official Projected Identity. Furthermore, since Curriculum 2005 has not yet been designed for the FET band (grades 8–12), the credibility of the 1st and 2nd orientations is undermined. In this pendulum swinging teachers are receiving contradictory messages. I believe that this pendulum swinging is problematic and that all four orientations are needed for learners to become competent in MLMMS.

I have argued that analysis of curriculum documentation for MLMMS reveals a radical shift in the philosophy of mathematics. Furthermore, during the phasing-in period of Curriculum 2005, contradictory education models ‘officially’ co-exist. This creates dilemmas for teachers who are expected to implement new learner-centred and locally relevant curricula while their schools continue to be judged on the performance of national examination results. I believe that this tension is reflective of broader tensions between the local and global. Curriculum 2005 attempts to satisfy both local and global demands in its drive to create mathematical meaning in local contexts while simultaneously competing internationally.

Wenger (1998) raises an important issue for teacher education in this respect. While national education departments can design roles they cannot design the (local) identities of teachers. The broader research study analyses teacher learning in terms of the relationship between the new mathematics roles, the generic roles for educators as outlined in the Norms and Standards Document for Educators (NDE, 2000) and developing teacher identities. In conclusion, I concur with Harley and Parker (1999) that teacher development in this context of change is far more complex than simply retraining teachers. Ways must be found to support teachers in developing new professional identities. They conclude that to implement these changes ‘teachers may well need first to shift their own identities, their understanding of who they are and how they relate to others’ (p.197).

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